

# Endemism and Isolation in the Three Kings Islands, New Zealand—With Notes on Pollen and Spore Types of the Endemics\*

By LUCY M. CRANWELL  
(Mrs. Watson Smith)

Honorary Botanist, Auckland Institute and Museum,  
Auckland, New Zealand

Research Associate, Geochronology Laboratories,  
University of Arizona, Tucson, U.S.A.\*

*"No explanation of distribution that does not explain endemism is of value. . . ."*  
J. C. Willis, 1949.

The Three Kings Islands lie about 33 miles northwest of Cape Maria van Diemen, itself linked to the New Zealand mainland by a sand tombolo of recent origin. The main islands, high, jagged and majestic, were given their present name by Abel Tasman when he sighted them on January 5 (Eve of Twelfth Night) 1643. They range in size from under 5 to 70 acres, Great Island reaching a height of 920 feet: smaller islets lie around them. They are affected by a warm current, so that the climate is humid, with much mist or fog conducive to a dense plant cover in areas not ravaged by burning, goats, or primitive agriculture. The sheer cliffs, however, have protected them from most visitors, so that few collectors can boast of a landing. Some areas were cultivated at times by the Maori inhabitants as late as 1840, but the most drastic changes in the flora probably occurred when goats were introduced to Great Island before 1887 (Cheeseman 1889) and again in 1889, as a source of food for castaways who might survive both the surf and the climb up the cliff faces.

According to the map given by Pantin (1959) in the very fine "Descriptive Atlas of New Zealand", the group lies at the outer boundary between the 100 and 500 fathom contours. Separation from the mainland has probably been effective for a long time, perhaps from the Lower Tertiary.

Most New Zealand biologists have shown interest in the group, while Croizat (1958) has stressed the importance of a supposed relict or "horstian" component. As in all discussions of that elusive condition, endemism, stimulus is added to phytogeographic theorizing when the extreme views of Croizat and of Willis, for instance, are contrasted. A host of milder views lie between as in the summaries provided by Cain (1944) and Good (1953). I hope that this small contribution will at least add fuel to a zestful fire.

Cockayne (1928 and earlier papers) early set up a special Botanical District for the Three Kings, as part of the North Auckland Botanical Province, noting the presence of four local endemics found by Cheeseman

---

\*This paper is entered as Contribution No. XX of the University of Arizona Programme in Geochronology.

I am indebted to the National Science Foundation, Washington, D.C., U.S.A., for assistance under NSF Grant G23159.

as support for this subdivision. To these four species — an *Alectryon*, a *Coprosma*, a *Davallia* and a *Pittosporum* — several important additions have been made, largely through adventurous collecting by members of expeditions sponsored by Auckland Museum. Now, with two monotypic genera and two families added to the terrestrial flora of the New Zealand region, Cockayne's judgment has been well sustained.

### CONTINENTAL IMPLICATIONS

Shales, greywackes and Cretaceous lavas were first reported from Great Island in 1936 by an old friend of the Museum, the late Professor J. A. Bartrum, who later showed (1948) that South-West Island was partly, if not wholly, composed of igneous rock indistinguishable in hand specimens from the older rocks. This younger volcanic series, which also occurs extensively at nearby North Cape, was considered to be Upper Cretaceous. Thus a hundred million years could lie between the deposition of these rocks.

The presence of ancient basement rocks, coupled with nearness to the New Zealand mainland, makes it clear that there is no need to invoke chance dispersal as a source of all the fauna and flora, though some species must have come in, early or late, as in the case of the Australian grass, *Chloris truncata*.

Oliver (1948) put the case for both accidental and continental affiliations, but favoured the former, with chance movements on air, as for the *Tecomanthe*, a member of the Bignoniaceae, because it has winged seeds, and for *Davallia*, because it has buoyant spores. He thought it a "fair conclusion" that almost everything had been derived from the mainland, the endemics merely representing migrants that had deviated after isolation from the parent stock. This view is in line with that of the general youthfulness of endemics, as urged by Willis throughout his life. If we accept this reasoning we are left with an assemblage of waifs and strays. Against it, as I hope to show, is the very nature of the endemism exhibited by a rather high percentage of the flora in particular.

Further, there is as yet no evidence that seeds of *Tecomanthe* are very airworthy. Comparison might be made with the dispersal of another tropical family, the Dipterocarpaceae — also with massively-winged seeds — which Ridley (1930), supported by Foxworthy (1946), has found to be carried only rarely by air, in the rain-forest, more than 30 or 40 yards from the parent tree.

Even the fern, *Davallia tasmanii*, has never been found on the New Zealand mainland, nor on the islands to the east. It is the only temperate outlier in a genus that still seems circumscribed — apart from the Pacific Islands — by the far-off influence of the Tethys Sea boundaries. Other species occur in Australia, but, according to Cheeseman (1925), ties with the Canary and Madeira species may be strongest. In both the fauna and flora of New Zealand there are genera with rather similar patterns of distribution, in some cases extending further west across the Atlantic to the Caribbean region as well.

Other islands of the New Zealand region, even on the outer verge of the 500 fathom contour, suggest continentality in the same way. Powell (1955, 1960) believes that the Aucklands, for instance, have "a basic fauna of relict New Zealand mainland origin." For the Three





Kings he stresses (1955) that the land-snail fauna of the Three Kings "is almost completely endemic . . ." and thus not to be explained by casual colonisation. Possibly the earwigs and the springtails described by Giles (1958) and Salmon (1948) respectively speak also for long isolation.

On more tenuous evidence—as no ancient basement rocks have ever been found in the Pacific—Professor C. F. Skottsberg has marshalled the case for continental ties between the Juan Fernandez Group and Chile, 400 miles to the east. In this he has accepted the very high percentage of unique woody genera, either endemic in the highest degree (being restricted to Juan Fernandez) or of a second rank (being restricted to the Group and to South America), as his chief evidence.

These same degrees of generic endemism, the unique and the localized, as exemplified by *Plectomirtha* and *Paratrophis* respectively, occur in the Three Kings flora, all (except for a sedge and a fern) being woody also.

Unfortunately no terrestrial fossil material has been found in the Group, so it is impossible to test opposing theories, or estimate whether isolation, even since the Tertiary, would necessarily cause much differentiation in the very homogeneous populations characteristic of, for example, the puka (*Meryta sinclairii*), with Polynesian affinities, or the one Australasian *Gymnelaea*, formerly known as *Olea aptala*.

It is possible that lavas have sealed in organic deposits of small extent. If these are ever found, a key to the history of the flora may be at hand. If they are fossiliferous the morphological studies of pollen and spores that follow will be of special value; in any case, they will be useful in Australasian and even wider researches.

In the meantime, there is much to be learned about the general and floral ecology of the species today. Is *Tecomathe*, for instance (cf. p. 229), visited by bats at dusk in its native habitat? Do its seeds float lightly on the wind, or do they twist and drop quickly, like a shuttlecock? In such studies may lie many of the answers to many pressing questions about migration in general.

A total of about 177 species of native flowering plants and ferns together with 22 introduced species (mainly on Great Island) has been reported from the group by Oliver (1948) and by Baylis (1958), and one monotypic endemic seaweed (*Perisporochmus*) has recently been described by Chapman (1954) in his survey of the algal flora.

The nature and varying degree of endemism in the terrestrial flora is briefly outlined below.

**A: Unique at generic level: affinities obscure:**

1. *Elingamita*, 2. *Plectomirtha*.

**B: Distinctive at specific or varietal level with close allies elsewhere:**

- (a) with congeners restricted to New Zealand lowlands:
  1. *Alectryon grandis*, 2. *Brachyglottis repanda* var. *arborescens*.
- (b) with congeners restricted to New Zealand and Pacific areas:
  1. *Coprosma macrocarpa*, 2. *Cordyline kaspar*, 3. *Hebe insularis*, 4. *Paratrophis smithii*, 5. *Pittosporum fairchildii*.



As will be seen later, three of the genera are centred in New Zealand at present, one in Australia, and one in Polynesia.

(c) with congeners centred in New Guinea and Australia; lacking on New Zealand mainland:

1. *Tecomanthe speciosa*.

(d) with congeners very widely dispersed:

1. *Carex elingamita*, 2. *Davallia tasmanii*.

## LOCALLY ENDEMIC SPECIES AND VARIETIES IN THE VASCULAR FLORA

Table I.

List of endemics and dates of first collections (*Coprosma macrocarpa* retained) as in Baylis, 1958.

G.I. = Great Island		N-E.I. = North-East Island			
S-W.I. = South-West Island		W.I. = West Island			
SPECIES		G.I.	S-W.I.	N-E.I.	W.I.
1	<i>Alectryon grandis</i> .. .. .	1889			
2	<i>Brachyglottis repanda</i> var. <i>arborescens</i>	1945			1950
3	<i>Carex elingamita</i> .. .. .	1889	1950	1947	1951
4	<i>Coprosma macrocarpa</i> .. .. .	1887	1889	1947	1951
5	<i>Cordyline kasper</i> .. .. .	1887	1887	1889	
6	<i>Davallia tasmanii</i> .. .. .	1887	1889		1950
7	<i>Elingamita johnsoni</i> .. .. .				1950
8	<i>Hebe insularis</i> .. .. .	1889	1889		
9	<i>Myrsine oliveri</i> = <i>Rapanca dentata</i> ..	1934			
10	<i>Paratrophis smithii</i> .. .. .	1887	1889	1947	1950
11	<i>Pittosporum fairchildii</i> .. .. .	1887		1947	1950
12	<i>Plectomirtha baylisiana</i> .. .. .	1945			
13	<i>Tecomanthe speciosa</i> .. .. .	1945			

## THE MICROSPORES: DESCRIPTIONS AND DISCUSSION

Many interesting pollen types are represented in the flora of the group, but it is my aim to concentrate at this time on those of the endemics, since their recognition may be of great value in the rapidly developing studies of ancient communities, their migrations, and the climates that influenced them.

Some of the finer morphological details will be discussed more fully in the Atlas of New Zealand microspore types being prepared by Mr. Neville Moar and myself. Neither form nor function is as easily understood as one could wish. In the European floras, for instance, many types have been known for over a hundred years, yet they are, according to the latest views of Dr. Gunnar Erdtman, still sorely in need of closer study. New Zealand types with rather unusual apertures, as in the *Coprosma*, *Elingamita* and *Myrsine* discussed here, are little understood, and need comparative study on a broad family basis, so that ancestral forms, perhaps less affected by adaptation to wind-pollination, may be recognized and then utilized in interpretation.

Pollen descriptions for three genera *Elingamita*, *Plectomirtha* and *Tecomanthe* have not hitherto been published.

### ALECTRYON Gaertn., 1788 SAPINDACEAE

About 20 species are known, the New Zealand pair being endemic. Duguid (1961) gives interesting observations on the erratic sexuality

of a tree of *A. excelsus* he has cultivated. During one season it was "quite smoky with bloom" (almost wholly male) for about two months, and set only a few fruit: two years later fruit was set in abundance.  
**1. *A. grandis* Cheesem., 1912.**

No flowers have been collected: the species was discovered by Cheeseman on Great Island in 1889. The single clump had dwindled to one poor tree, seen by Baylis in 1945 and then by Turbott and Bell in 1946.

As affinity with the mainland Titoki (*A. excelsus* Gaertn.) is very close it is not likely that the pollen grains would differ significantly. In Titoki (Cranwell, 1942, p. 299) they are small ( $18\mu$ ), with three long furrows and rounded pores on the equator.

The Hawaiian *A. macrococcus* Radkl. has slightly larger grains with distinctive arcs running between the pores to cut off polar triangles: this condition, which seems fairly common in the Sapindaceae, is well illustrated by Selling (1947, Pl. 27, figs. 405-409).

*Alectryon* is a Western Pacific genus ranging from Australia eastward to Hawaii. As the oldest fossil record is from the New Zealand Miocene (Couper 1953), a northern origin is suggested; however, as the pollen is so distinctive it would be well to re-open the question as to whether the other species, formerly grouped in *Nephelium*, should really be included in *Alectryon*.

### BRACHYGLOTTIS Forst., 1776 COMPOSITAE

A monotypic genus related to *Senecio*: restricted to the New Zealand lowlands. The variety whose pollen is described here was given specific rank by Oliver (1948) but was reduced by the late Dr. H. H. Allan (1961).

**2. *B. repanda* J. R. et G. Forst. var. *arborescens* (W. R. B. Oliver) Allan. Pl. III, figs. 15, 16.**

Pollen grains spheroidal, tricolporate, about  $24-28 \times 23-27\mu$ ; furrows meridional, long, narrow, tapering; pores rounded, as wide as furrows where they cross equator ( $3\mu$ ); exine densely spiny, about  $3.5\mu$  or thicker midway between furrows, the spines sharp, with broad bases, regularly arranged, opposed in pairs along furrow margins.

**Distribution:** Endemic to two islands of Group (see Table I): first collected by Baylis, December 1, 1945.

**Flowering:** December. Insect-pollinated; seed with pappus.

**Affinities:** Apparently very close to the common mainland species.

**Pollen preparations:** Great I., G. T. S. Baylis, Dec. 1, 1945, A22, S199 (acetolysed, and lactophenol methods): ex herb. Auck. Mus., 22847

**Fossil range of genus:** Tentative records of pollen of this type were given by Couper (1953). No records of this family older than Mid-Tertiary are confidently given for New Zealand.

### CAREX L.

### CYPERACEAE

Eighteen species of this family are reported. Some of these may well have come in after settlement, or on the feet of seabirds, though Skottsberg in particular has pointed to the poor representation in the

Pacific in spite of seeming superiority in dispersal mechanisms.

### 3. *C. elingamita* Hamlin, 1958. Pl. II, fig. 6.

Pollen grains with several vaguely indicated patchlike apertures, irregular in size and shape, mainly pear- or top-shaped, ranging from 32-41 x 30-32 $\mu$  in size; apertures poroid, about 7 $\mu$  long, with ragged outlines, four usually present, one always discernible at broad end of grain; exine thin, firm, tectate, the pattern consisting of small rods running towards the surface or fully exposed (and larger) where tectum is lacking over the apertures.

**Distribution:** Endemic to Group. First collected by Cheeseman in 1889. See Table I.

**Flowering:** Mainly wind-pollinated.

**Affinities:** See Hamlin (1958).

**Pollen preparations:** Ex herb. Auck. Mus. 2839, collected by T. F. Cheeseman, Nov., 1889; A3, G61, acetolysed.

**Note on *Carex* pollen:** Few monocotyledons have more than one aperture: the possession of four in *Carex* is an unusual feature due to the dissolution of walls between the tetrad units, each of which would have had a single pore. Such a grain has been called a "false tetrad", or "pseudotetrad" as it really is only the ghost of a normal tetrad.

**Fossil range of genus:** Surprisingly short, in spite of its wide distribution over the face of the globe. The oldest New Zealand records appear to be mid-Tertiary; no authentic Cretaceous pollen finds are known. The exines are delicate, but occur abundantly in many peats and coals so there should be no difficulty in recognizing the grains if they are present in a deposit.

## COPROSMA J. R. et G. Forst. 1776 RUBIACEAE

About 90 species, typically dioecious, are known, 45 in New Zealand (all but one endemic: Allan, 1961), then ranging west to Tasmania and Australia, north to New Guinea, and east to Hawaii and Juan Fernandez. Absent from South America, though the closely related *Nertera* grows there: fossil leaves from Chile have been attributed to the genus, but the material needs critical revision. No older Tertiary pollen records east of New Zealand.

### 4. *C. macrocarpa* Cheesem.

Pollen grains tricolporate, spheroidal, often flattened over poles, markedly triangular or rounded-triangular in equatorial outline, about 31.6 x 25 $\mu$  (28-34 x 18-28 $\mu$ ); apertures midway between angles of grain, meridional, very short, slitlike, about 9 $\mu$  long, with dense rims usually pressed together, underlain by vestibules of large size, running the length of the slits and almost coalescing at angles of grain; exine firm, rather thick, 2 $\mu$  or more, tectate, the rod pattern stronger around apertures and over polar triangle.

**Distribution:** Table I shows distribution on the Three Kings. Cheeseman considered this plant endemic to the Group. Very similar forms with small fruit are known from the Auckland Province, however.

**Flowering:** Wind-pollinated, with freely exposed anthers, as in all members of the genus.



**Affinities:** Comparable forms with much smaller fruit occur in northern mainland as far as 37° S. lat.; these forms may be co-specific, as treated by Allan (1961).

**Pollen preparations:** Ex herb. L.M.C., grown in Opotiki by N. Potts; S467, acetolysed.

**Fossil range:** Couper (1960) does not give records older than Middle Oligocene. In the Paparoa beds I have found *Coprosma* grains that may be Oligocene, or perhaps Eocene. I have also found fairly high frequencies (up to 5%) in subfossil peat collected for me by Dr. A. W. B. Powell on the Chatham.

### CORDYLINAE Comm. ex Juss. AGAVACEAE

About 20 species known, with 5 endemic in New Zealand, together with one cultigen known from Polynesia to India: the other species grow in and around the Pacific, but there is one outlier in South America.

#### 5. *C. kaspar* W. R. B. Oliver, 1948. Pl. 11, Figs. 7-10.

Pollen grains monocolpate, conspicuously flattened on distal side, bulging when expanded or deeply channelled when unexpanded on opposite (proximal) side, about 30-36 $\mu$  x 20-30 $\mu$ ; furrow longer than grain, wide (about 10 $\mu$ ) and very distensible, without well-defined margins; exine firm, dense, under 2 $\mu$  thick, only slightly roughened on surface, with walls of about equal thickness, the outer carrying the fine rods (bacula) in a crowded pattern; furrow membrane thinner; intine thick under furrow.

[The grains were probably rather immature as some adhered in their tetrads and others were unexpanded. Stronger exine pattern may be characteristic of riper material.]

**Distribution:** Lacking only on West Island (see Table I).

**Flowering:** Late spring and early summer insect- and probably bird-visited for its nectar.

**Affinities:** Closely allied to the lowland trees, *C. australis* and *C. banksii*, both of which grow on the islands. I have seen a hybrid between these two, at Anawhata on the West Coast near Auckland, which had comparably wide foliage. The light exine pattern of *C. kaspar* and its allies sets it apart from the montane *C. indivisa* which has a very rough surface.

**Pollen preparations:** Great I., Baylis, Dec. 1, 1945, ex herb. Auck. Mus. 22851 (A5, acetolysed; glycerine).

**Fossil record for genus:** Apparently the pollen is rather freely air-borne (Licitis, 1953) and may thus be expected to occur in organic deposits. Couper (1953) reports it from mid-Tertiary and later deposits in New Zealand but there are no records elsewhere to help trace the ancestral home of the genus. At present it would seem that the New Zealand species are part of an Oligocene influx from warmer regions. The South American species presents a special problem in distribution.

### DAVALLIA J. E. Smith, 1793 DAVALLIACEAE

About 40 species, all epiphytic, are scattered from the Canary Islands to Madagascar and New Zealand (one species only), and especially in East Asia and the Pacific Islands. Manton and Sledge

(1954) suggest that  $n=40$  is the base number for the genus. Brownlie (1961) reports the same number for the Three Kings species.

**6. *D. tasmanii* Cheesem. ex Field. Pl. I, figs. 1, 2; Pl. II, figs. 3-5.**

Spores monolete, medium-sized, bean-shaped (plano-convex), slightly recurved at ends towards dehiscence scar (laesura) on flatter side, mainly about  $54 \times 34 \times 34\mu$ , equatorial outline rounded-elliptic; scar lips (commissures) smooth, flat, sharply delimited (especially after compression), usually more than half length of long axis; exine about  $3\mu$  thick, smoothly verrucate except over scar area; outer wall (when visible) very thin, covering low crowded bosses (verrucae) uniformly; endexine very thin.

**Size-range:** Size varies greatly according to method of preparation. In lactic mounts swelling is considerable. Apart from obviously swollen examples most lie between  $46-60 \times 27-39\mu$ . A few long narrow spores ( $60 \times 30\mu$ ), apparently sterile, were noted.

**Distribution:** Endemic to Three Kings (see Table I). It is interesting to note that the species has not spread in recent times to the mainland, or to the Kermadecs.

**Affinities:** *D. canariensis* is said to be closely related. I have therefore checked fresh herbarium material of this species, collected by Dr. W. A. Sledge on the island of Madeira, and grown by him in Leeds. The spores in this species differ (as shown also by Erdtman, 1957, Fig. 99) in the larger, more pointed and less crowded bosses; in Erdtman's picture, at least, the outermost wall is lacking. The scar and "prow" ends (as in an Indian canoe) are well marked, but the former seems to widen more under pressure than does that of the Three Kings species.

**Spore preparations:** From Cheeseman's original collection: (a) Sc974, acetolysed; lactic, ex herb. Auck. Mus., 419, (b) G97, acetolysed, ex herb. Hort. Reg. Kew ("recd. 5/1889").

**Fossil range of genus:** Warty spores of this type have been reported by Dr. R. A. Couper (1953), and by Dr. Suzanne Duigan (1956) for Australia. Apparently, according to Professor R. Potonié, these should be included in the form genus *Verrucatosporites*.

As *Davallia*-like spores occur widely in the Polypodiaceae (to which many still refer *Davallia* and its allies) exact generic identification is made difficult, or impossible. It would be interesting, for example, to be able to distinguish the spores of *Microsorium* (*Polypodium*) *diversifolium*, common in New Zealand, from those of the *Davallia*, but, as their ecological requirements are similar little would be gained for climatological interpretation. Nothing is known about the history of *Davallia* in southern lands but it is probable that it could have entered the New Zealand region from the north, where the bulk of the species now grows (see p. 216).

**Note:** Harris (1956), see Pl. 7, fig. 1, has already described the spores of *D. tasmanii*, cultivated on Kapiti I. off the West Coast of New Zealand. I was more fortunate in having access to collections made by Mr. T. F. Cheeseman and have thus thought it worth confining my description to the type material. The differences I have observed may merely be due to immaturity of some of the spores already described.



**ELINGAMITA** Baylis 1951 **MYRSINACEAE**

A monotypic endemic: the pollen, which is of a very distinctive type, will perhaps give further clues to family position. The name commemorates the tragic loss of the ship "Elingamite" in 1902, in a fog on West Island, "beneath the cliffs on which the tree grows" (Baylis, 1951).

**7. E. johnsoni** Baylis 1951. Pl. III, figs. 11, 12.

Pollen grains prolate or oblate spheroidal, tricolporate, rounded or deeply lobed in equatorial outline according to state of expansion, about  $19 \times 15\mu$  ( $16-27 \times 13-18\mu$ ); polar field narrow; furrows very long and narrow, tapering little, meridional and either straight or sinuous; pore equatorial, about  $7\mu$  in diameter, geniculate, the outer wall bulging to form vestibules about rectangular inner apertures which may link around equator like cross furrows; exine very thin, smooth, outer wall continuous over pores, middle wall with slight rod pattern (coarser around inner apertures), innermost wall also thicker around inner apertures.

**Distribution:** West King only. Collected by Major M. E. Johnson for the first time in 1950, then by Baylis in 1951, when about a dozen trees remained in windswept scrub.

**Flowering:** January (flowers and fruit together) on West King. Date of flowering in Auckland (S650) not available. Flowers "cream coloured", the stamens extending beyond the short corolla, a good indicator of wind-pollination, as the pollen grains are small and suitable for this method of pollination.

**Affinities:** Not clear at present. See discussion by Baylis (1951) who suggests relationship with certain monotypic genera in Malayasia and the Pacific islands. It is too early to suggest whether this has been a northern or southern element in the flora.

**Pollen preparations:** (a) from type material, ex herb. Auck. Mus., 36263, S650, S655, acetolysed and lactophenol preparations, and (b) from a plant grown by Mr. W. Farnell in the grounds of Auckland Hospital Board; ex herb. Auck. Mus. 50942.

**Note on geniculate pollen types:** No other New Zealand member of the family has well defined pores, and few families in any flora have the bulging (geniculate) germinal apparatus characteristic of the species described. It is thus possible that relationship should be sought in some family with comparable pollen type. The geniculate pore occurs in rather few families and genera, to my knowledge. Stanley and Kremp (1959) list various families in which it occurs, or may occur.

**HEBE** Comm. ex Juss. 1789 **SCROPHULARIACEAE**

Allan (1961) recognized about 100 species, "mostly endemic in N.Z. but two shared with S. America and one of them extending to Falkland Is.; a few spp. in Tasmania, south-east Australia and New Guinea." New Zealand claims 79 of these species and 11 of *Parahebe*. According to incomplete studies I have made of the pollen the size range in the two genera is from  $18\mu$  to  $39\mu$ , the largest grains being in *Hebe buxifolia* ( $30-39\mu$ ), and the smallest in *H. ciliolata*.

**8. H. insularis** (Cheesem.) Ckn. et Allan 1926. Pl: III, figs. 13, 14.



Pollen grains tricolpate, rather small, about 33-36 $\mu$ , spheroidal, deeply lobed in equatorial outline, especially when unexpanded; polar field wide; furrows meridional, very long, wide on equator, tapering towards the poles, their membranes thin, very distensible, tending to rupture above and below equator, margins weakly delimited over most of their length; exine firm, almost or completely smooth, about 2 $\mu$  thick, a little thicker in polar area, tectate, the two walls of about same thickness, endexine thinner, pattern rather obscure, seemingly sub-reticulate, the rod elements spread evenly over whole surface.

**Distribution:** Found only on Great I. and South-West I. The removal of goats may result in the spread of the species beyond the rocky areas in which it had previously been noted by Cheeseman and Baylis.

**Flowering:** November and December (Cheeseman, 1897). Insect-pollinated. Heine (1937) lists a wide range of vectors for *Hebe*.

**Affinities:** Comparisons have been made with *H. diosmifolia* and some Chatham species, but its position is not clear.

**Pollen preparations:** Great I., Cheeseman, 1889, ex herb. Auck. Mus. 7888 (A45, acetolysed); Baylis, Dec. 2, 1945, ex herb. Auck. Mus. 22824 (A96, acetolysed).

**Fossil range of genus:** Little is known about history and nothing about the homeland of the genus. As already indicated New Zealand is its present focus. The small tricolpate pollen grains are characteristic of the *Hebe-Parahebe* complex: they are fairly distinctive (Cranwell, 1942). They adhere closely and are unlikely to be spread far by the wind: reports even from sub-fossil deposits are rare.

## MYRSINE L., 1753 MYRSINACEAE

A small genus in a widespread family of about 1000 species, which are mainly tropical or subtropical. Hosaka (1940) discussed *Myrsine*, in a wide sense, and Croizat has given prominence to the family in various recent books on plant distribution.

9. *M. oliveri* Allan (syn. *Rapanea dentata* Oliver). Pl. III, fig. 20.

Pollen grains tricolpate, subglobose, often shallowly lobed, about 19 x 18 $\mu$ ; apertures meridional, short, slitlike, or opening wide like pores under pressure; their membranes covered with coarse granules but margins only slightly roughened; exine thin, firm, smooth, tectate, the inner wall finely granular and only slightly thicker than outer wall.

**Distribution:** Great I.

**Flowering:** December; wind-pollinated, the smallish flowers said to be inconspicuous and slightly pink. The pollen of tree species on the mainland have been reported by Clark (1951) and Licitis (1935) from air plankton surveys in the Wellington district.

**Affinities:** Distinct from the coastal forms immediately to the south. The systematic study of the *Myrsine-Rapanea-Suttonia* complex presents many difficulties but the pollen grains offer only minor differences, mainly in the aperture areas. Reference should be made to Selling's treatment of the Hawaiian species (1947).

**Pollen preparations:** S200 (acetolysed); Great I., collected by G. T. S. Baylis, Dec. 5, 1945; ex herb. Auck. Mus. 22871.

**Fossil range of genus:** As the three genera just mentioned cannot at present be separated on pollen characters I am treating them as one unit, wide-ranging in time and space, as in recent Hawaiian, New Zealand and South American deposits, and in ancient ones of New Zealand and Antarctica. I believe that this small pollen type may be one of the most useful for southern pollen studies.

### PARATROPHIS Blume, 1852 MORACEAE

About 60 genera in the family, mainly in hot regions. *Paratrophis* has 10 species in Polynesia and three endemic to New Zealand.

#### 10. *P. smithii* Cheesem. Pl. III, fig. 17.

Pollen grains subglobose or collapsed on one side, obscurely 2-4 pored, about 16-20 $\mu$  in diameter; pores circular, about 2-3 $\mu$  across, with a small operculum sometimes persisting; exine thin, firm, smooth, obscurely flecked; intine thick.

**Distribution:** Restricted to Three Kings. See Table I.

**Flowering:** Late spring. Wind-pollinated; pollen whitish.

**Affinities:** The species is seemingly not closely allied to mainland forms.

**Pollen preparations:** Ex herb. Auck. Mus., 3771, collected by T. F. Cheeseman, EM 336, acetolysed.

**Fossil range of genus:** Not known. The very small moraceous pollen type may be difficult to identify with certainty. A close study of older deposits might, however, lead to much information about the former distribution and migrations of the genus.

### PITTOSPORUM Banks ex Gaertn. 1788 PITTOSPORACEAE

Twenty-six of the 160 or so species are endemic to New Zealand. The remainder is scattered from Macronesia (1), Abyssinia (1), South Africa (1) and Madagascar (1) to Australia (the great majority), China and Japan (1) and Hawaii (23). Insect-pollinated. Australia is the centre for this very uniform family, whose relationships are obscure.

#### 11. *P. fairchildii* Cheesem. 1888. Pl. IV, figs. 23, 24.

Pollen grains tricolporate, spheroidal, usually flattened over poles, distinctively rounded-triangular in equatorial outline, depressed where furrows cross equator, mainly 21-30 x 23-27 $\mu$  (but sometimes reaching 35 $\mu$ ); furrows very long, tapering, with clearly defined margins; pores rather large, running transversely, strongly rimmed, rectangular or extending raggedly beyond limits of furrow, protruding strongly under pressure from cell contents but sunken when contents destroyed; exine smooth, firm, rather thin near furrows, but about 2.5 $\mu$  thick midway between furrows, tectate, with small rods underlying arranged in a net-like pattern, but somewhat obscure; endexine thin, extending over furrow and pore areas; intine thick under poles.

**Note on variation in the material:** The diversity in exine pattern is shown in the accompanying photomicrographs. In old preparations the outer walls appear to separate, but this is probably an artifact. Acetolysed pores (without KOH) showed up poorly because of the infolding of the wide furrows. All grains are distinctive, however, in their general appearance and should not be confused with any other in



the flora, though there have been comparisons with the grains of *Coprosma*. A monographic study of *Pittosporum* would be very useful, I believe, for phytogeographic studies. It seems that the African *P. viridifolium*, for instance, is rather separate from the New Zealand and Hawaiian material. I was fortunate to receive material of this species for comparison from Dr. M. Levyns, of Cape Town.

**Distribution:** Great I., "above north landing" according to Cheeseman (1888) and "where the shores are broken with boulders" (Fraser, 1929).

**Flowering:** August-September (i.e., early spring).

**Affinities:** Cheeseman has compared it with the common coastal species to the south, *P. crassifolium* and the more local *P. umbellatum* of the East Coast only. These two species are separated in Cooper (1956) whose key indicates that the 3-valved New Zealand species are linked with the two from more northerly Norfolk and Lord Howe Islands. This may provide a clue to old migrations, but it seems from statements in Allan (1961) and in Cooper that valve number in the capsule may vary from 2-3, or 3-4 in some species. Whatever the significance of the valve number, the ties do appear to be closer with these islands than with Australia.

**Pollen preparations:** Ex herb. D. Petrie, 287 (in Auck. Mus. herb.), EM 255; cultivated by N. Potts, Opotiki, S622, both acetolysed.

**Fossil record for genus:** No pollen records for New Zealand.

#### PLECTOMIRTHA Oliver 1948 ?ANACARDIACEAE

The Three Kings species is the only one known. Its pollen grains have not previously been described.

12. *P. baylisiana* Oliver 1948. Pl. III, figs. 18, 19.

Pollen grains typically tricolpate, spheroidal, usually flattened over poles, about 20-26 x 23-26 $\mu$ , polar field very wide; apertures broad, slitlike, meridional, opening widely under pressure and usually causing little lobing of the equatorial outline; exine firm, dense, up to 2 $\mu$  thick, almost perfectly smooth, tectate, with a fine rod layer in outer wall; endexine thinner than exine.

**Note:** A few grains showed obscure bulging of the apertures but did not throw light on their exact nature.

**Distribution:** Great Island only, at 700 ft. altitude: "only one tree found" (Baylis, 1945). This tree was visited by Turbott and Bell in 1946.

**Flowering:** Probably wind-pollinated.

**Affinities:** Said by Oliver (1948) to be close to *Semecarpus*, one of the most poisonous members of the Anacardiaceae. It is to be hoped that the chemistry of the Three Kings plant can be studied when more foliage, and seeds, are available. As yet there have been no records of contact dermatitis due to handling. In my opinion the pollen type is unlike any reported from this much-studied family, many of whose members differ in their distinct pores and reticulate (or striate) exines (cf. Erdtman, 1952).

When more material is available it will be possible to check the pollen characters more fully, and thus find fuller clues to affinities. Allan (1961) has also left open the question of family standing.



**Pollen preparations:** S271, S655, P158 (all acetolysed), from type specimen collected by Baylis, Dec. 2, 1945; ex herb. Auck. Mus. 22875.

**Fossil records:** Nothing of the kind has been reported from the New Zealand area.

### TECOMANTHE Baill. 1888 BIGNONIACEAE

*Tecomanthe*, with 20 or more species centred in Melanesia, is a genus of woody climbers. The family comprises over 750 species and is almost wholly tropical, with the main focus today in Brazil: it is adapted to pollination by birds in particular, and, in some cases, by bats.

**13. T. speciosa** Oliver 1948. Pl. IV, fig. 22; Pl. V, figs. 27-30.

Pollen grains tricolpate, spheroidal, rather large, mainly  $44-47\mu$  in greatest diameter, equatorial outline rounded or deeply lobed, according to state of expansion; polar field wide; furrows long, broad, tapering, about  $8\mu$  on equator, thickened along most of margin; "pores" riftlike, poorly defined, opening mainly above and below equator; exine mainly intectate, reticulate, slightly roughened on surface, up to  $3.4\mu$  thick in areas midway between furrows, reduced in thickness and pattern towards furrow margins, rods of reticulum long, rounded at tips, crowded over poles and furrow margins; furrow membrane covered by stiff wall of exine.

**Distribution:** See Table I. Baylis (1958) states that the species is restricted to Great Island and is erroneously reported from North-East Island. As already noted (p. 218) the large winged seeds are unlikely to travel far on wind or ocean currents.

**Flowering:** Records for May, June, and, more doubtfully, July, are noted by Allan (1961). Hunter (1958) has described fruit from a cultivated plant which bloomed first in May 1954 but did not set seed, even with hand pollination, until July 1956, the capsules then taking 8 months to mature. This plant flowered as late as early August, "inflorescences tending to develop on the younger wood towards the end of the flowering season, as distinct from the cauliflory common at the beginning." The anthers are orange. It is interesting to note that kohekohe (*Dysoxylum spectabile*) is another winter-flowerer in New Zealand.

**Affinities:** The Three Kings species is said to be closest to *T. hillii* of eastern Australia (the only Australian species). Differences have been stated by Oliver (1948) and more recently by Hunter (1958) who has shown how much larger are the pods in *T. speciosa*. Significant, though minor, differences occur in the pollen grains but comparisons will be held for a comparative paper involving *Tecomanthe* in a wide sense. It seems clear, on the evidence now available, that the New Zealand species has not been derived very recently from the supposed parent stock to the north.

**Pollen preparations:** Great I., E. G. Turbott, May, 1946, ex herb. Auck. Mus. 23097; S225, S250, acetolysed; cultivated (a) in Whangarei by Mrs. W. Reynolds, May 23, 1960, temporary preparations; (b) in Auckland, by Plant Diseases Division, D.S.I.R., Mount Albert, from cutting taken on Great I. (ex. herb.), July 17, 1959, A4, acetolysed.

**Comparative:** *T. hillii* (F. Muell.) van Steenis. Ex herb. Hort. Reg. Kew collected by F. Turner, N.S.W.; A15, S954, acetolysed. Pollen of other species of *Tecomanthe* etc. were also studied.

**Fossil range for family:** No records for *Tecomanthe*, but they may turn up in the New Guinea-Australia-New Zealand triangle. In various parts of the world Cretaceous and younger deposits have yielded macrofossils attributed to the Bignoniaceae, as for example in Chile and in the London Clays of Britain.

**The Campsis-Pandorea-Tecomanthe complex:** Van Steenis (1928) mentioned the need to merge these genera. The pollen samples he has sent me show few differences, partly because there is great uniformity in 3-furrowed types in the family. Merging, while drawing attention to an older entity, would, however, veil the very real geographic segregation of the taxa as they exist today. *Pandorea* and *Tecomanthe* both occur in Melanesia, but *Campsis* is restricted to East Asia and the eastern United States. As has been indicated, tropical or sub-tropical origins seem reasonable for *Tecomanthe speciosa*. The possibility that it (and *Dysoxylum spectabile* also) have bat flowers strengthens the view that the plant came from hot regions; it could have lost its association with flower-visiting bats long ago. The flower of *Tecomanthe speciosa* lacks the heavy reddish tones common in bat flowers [see work on *Kigelia*, of the same family, by Harris and Baker (1958) and by Baker (1961)], but it is inverted in the same way, and is held clear of the stem. Some of the tropical species are known to have dark flowers.

### A ROLE FOR POLLEN AND SPORE STUDIES AT THE GENERIC LEVEL

To sum up, the facts surveyed seem to favour the view that the biota of the Three Kings may be largely relict and that they have somehow preserved both northern and perhaps southern forms that have died out on the mainland, or may never have reached it in the case of warmer types that moved in pulsations along the northern arcs.

While so much points to an immediate tropical source, ultimate derivations are another matter. Pollen of bignoniaceous types, for instance, should therefore be sought in order to find the complete range of the family in time and space. Dr. Couper's finds (1960) of Oligocene *Bombax*-like grains stress how valuable their study can be in phytogeography. Such finds may present many surprises, so, although we can agree with Willis (1949) that the study of endemism is very important, our fossil studies tend more and more to deny his vehement belief that it "obeys definite laws" or that the endemics are most commonly "young beginners as species or genera."

For this reason the preservation of such rich areas as the Three Kings takes on special importance as an ancient repository where old and new mingle just as they do in a home that has been in the hands of a family for many generations. The need for sympathetic care of such areas and especially for protection from feral browsing animals, cannot be over-stressed.

### ACKNOWLEDGEMENTS

I am happy to acknowledge the assistance of the following New Zealand friends and colleagues in assembling fertile herbarium material, either wild or cultivated, for microspore studies: Professor G. T. S. Baylis, Otago University, Dr. Robert C. Cooper, Botanist, Auckland Institute and Museum, Mr. W. Farnell, Auckland, Miss Lucy B. Moore,



M.B.E., Botany Division, Christchurch, Mr. Norman Potts, Opotiki, Mrs. W. Reynolds (Katie Pickmere), Whangarei, Mr. E. Graham Turbott, Assistant-Director, Canterbury Museum, Christchurch; cultivated material of *Cordyline kaspar* and a photograph of flowering *Tecomanthe speciosa*, taken by Mr. Harley Powell, was also made available by The Director, Plant Diseases Division, D.S.I.R., Mount Albert, Auckland. In addition, spores of *Davallia canariensis* were sent by Dr. W. Sledge, of Leeds University, while Sir George Taylor, Director of the Royal Botanic Garden, Kew, England, sent fertile *D. tasmanii*, and samples of *Tecomanthe hillii* from Australia.

Other comparative material—eight species from five genera representative of “curious ancient members” of the Bignoniaceae in the New Guinea flora—was sent by Professor C. G. G. J. van Steenis of the Rijksherbarium, Leiden, Holland.

To Dr. H. G. Baker of the University of California, Berkeley, I am indebted for literature and comments on bat flowers, and to Professor Knut Faegri, Botanical Museum, Bergen, Norway, for discussion of the furrow condition in *Tecomanthe*.

Constant use of the new “Flora” (Allan, 1961) was made during my work.

#### TERMS USED

##### General:—

**Cauliflory:** A condition in which flowers are borne on old trunks or on woody branches. New Zealand examples: Kohekohe (*Dysoxylum spectabile*), *Tecomanthe speciosa*. **Flagelliflory** occurs in this group, the flowers being arranged on hanging, whiplike stems, which may be exceedingly long, as in *Kigelia americana*, the sausage tree.

##### Concerning microspores:—

I have kept to simple descriptive terms as far as possible, following the usage of Faegri and Iversen in their “Text-Book of Modern Pollen Analysis” (1950), now in general use. A few terms only are defined below. For fern-spore terminology reference should be made to Harris (1955).

**Colpate:** Possessing furrows; **Colporate:** with furrows and associated pores.

**Exine:** Outer, layered wall of pollen grains and spores. Very resistant to almost all acids. **Ectexine:** outermost wall, sometimes with fused rod elements making a roof (*Tectum*) over all or most of the grain.

**Endexine:** inner wall, very uniform in appearance. Erdtman advocates the use of the terms “sexine” and “nexine” for these layers, respectively: these are good terms in themselves but not better, I think, than the older ones.

**Geniculate:** e.g., in *Elingamita*. From *geniculus*, as used by Potonié in 1934 to describe the bulging outlines of some apertures. The exine separates to form a “blister top” above the pore area and a floor below, with a vestibule between. Stanley and Kremp (1959) illustrates this condition for a *Quercus* and suggest that it may be intermediate between the tricolpate and the tricolporate; this may be true for *Quercus* as the Fagaceae may be of both types, perhaps as a result of varying response to wind-pollination, but in *Elingamita* the appearance is of a very specialised tricolporate development.



**Intine:** The innermost wall, destroyed by alkali treatment and by acetolysis, and hence rarely described. Usually thin, but thick all over, or locally, in some families, e.g. Fagaceae, and then important in rupturing the exine at germination, e.g. in *Nothofagus menziesii*-type grains. Knowledge of the intine is of special value when dealing with living or mildly treated material, as for aerobiological studies.

**Monolete:** With the tetrad scar forming a single line of dehiscence. In *Trilete* spores (e.g., those of *Hymenophyllum*) the scar is 3-armed (triradiate).

## LITERATURE

- ALLAN, H. H., 1961. Flora of New Zealand. Govt. Printer, Wellington, New Zealand.
- BAKER, H. G., 1961. The adaptation of flowering plants to nocturnal and crepuscular pollinators. *Quart. Rev. Biol.*, 36: 64-73.
- BARTRUM, J. A., 1948. Report on rocks collected by Mr. G. A. Buddle from islands of the Three Kings Group. *Rec. Auck. Inst. Mus.*, 3: 205-206.
- BATTEY, M. H., 1951. Notes to accompany a topographical map and a provisional geological map of Great Island, Three Kings Group. *Rec. Auck. Inst. Mus.*, 4: 93-97.
- BAYLIS, G. T. S., 1951. *Elingamita* (Myrsinaceae) a new monotypic genus from West Island, Three Kings. *Rec. Auck. Inst. Mus.*, 4: 99-102.
- , 1958. A botanical survey of the small islands of the Three Kings Group. *Rec. Auck. Inst. Mus.*, 5: 1-12.
- BROWNLIE, G., 1961. Additional chromosome numbers — New Zealand ferns. *Trans. Roy. Soc. N.Z., Bot.*, 1: 1-4.
- CAIN, S. A., 1944. Foundations of plant geography. New York, Harper.
- CHEESEMAN, T. F., 1888. Notes on the Three Kings Islands. *Trans. N.Z. Inst.*, 20: 141-150.
- , 1891. Further notes on the Three Kings Islands. *Trans. N.Z. Inst.*, 23: 408-424.
- , 1892. On some recent additions to the New Zealand flora. *Trans. N.Z. Inst.*, 24: 409-412.
- , 1897. On some plants new to the New Zealand flora. *Trans. N.Z. Inst.*, 29: 390-393.
- , 1925. Manual of the New Zealand flora. Ed. 2. Govt. Printer, Wellington, New Zealand.
- CLARK, Helen, 1951. An atmospheric pollen survey of four Centres in North Island, New Zealand, 1949-50. *N.Z. J. Sci. Tech.*, B33: 73-91.
- COCKAYNE, L., 1928. The vegetation of New Zealand. Leipzig.
- COOPER, R. C., 1956. The Australian and New Zealand species of *Pittosporum*. *Ann. Missouri Bot. Gard.*, 43: 87-188.
- COUPER, R. A., 1953. Upper Mesozoic and Cainozoic spores and pollen grains from New Zealand. *N.Z. D.S.I.R. Pal. Bull.* 22. Govt. Printer, Wellington.
- , 1960. New Zealand Mesozoic and Cainozoic microfossils. *N.Z. D.S.I.R. Pal. Bull.* 32. Govt. Printer, Wellington.
- CRANWELL, Lucy M., 1942. New Zealand pollen studies. I. Key to the pollen grains of families and genera in the native flora. *Rec. Auck. Inst. Mus.*, 2: 280-308.
- , 1953. New Zealand pollen studies: The Monocotyledons. *Auck. Mus. Bull.*, 3. Harvard University Press.
- CROIZAT, L., 1958. Panbiogeography. Vols. IIa, b. Published by the author. Caracas.
- DUGUID, F. C., 1961. Flowering in Titoki. *Wellington Bot. Soc. Bull.*, 32: 16.
- ERDTMAN, G., 1952. Pollen morphology and plant taxonomy. Angiosperms. (An introduction to palynology. I.). Almqvist & Wiksell, Stockholm.
- FOXWORTHY, F. W., 1946. Distribution of the Dipterocarpaceae. *J. Arn. Arb.*, 27: 347-354.
- FRASER, W. M., 1929. Notes on a visit to Three Kings Islands. *N.Z. Jour. Sci. Tech.*, 11: 148-156.

- GILES, E. T., 1958. Dermaptera from the Three Kings Islands, New Zealand, with the description of a new species of *Brachylabis* Dohrn (Labiduridae). *Rec. Auck. Inst. Mus.*, 5: 43-48.
- GOOD, R., 1953. The geography of the flowering plants. 2d ed. (New impression, 1961). London, Longmans.
- HAMLIN, B. G., 1958. Studies in New Zealand Carices IV and V. *Trans. Roy. Soc. N.Z.*, 85: 387-396.
- HARRIS, B. J. and BAKER, H. G., 1958. Pollination in *Kigelia africana* Benth. *J. West African Sci. Ass.*, 4: 25-30.
- HARRIS, W. F., 1955. A manual of the spores of New Zealand Pteridophyta. *D.S.I.R. Bull.* 116. Govt. Printer, Wellington.
- HEINE, E. M., 1937. Observations on the pollination of New Zealand flowering plants. *Trans. Roy. Soc. N.Z.*, 67: 133-148.
- HOSAKA, E. Y., 1940. A revision of the Hawaiian species of *Myrsine* (*Suttonia*, *Rapanea*), Myrsinaceae. *Occ. Pap. Bishop Mus.*, 16: 25-76.
- HUNTER, J. A., 1958. Additional notes on *Tecomanthe speciosa* W. R. B. Oliver (Bignoniaceae) from the Three Kings Islands, near New Zealand. *Rec. Auck. Inst. Mus.*, 5: 41-42.
- LICITIS, R., 1953. Air-borne pollen and spores sampled at five New Zealand stations, 1951-52. *N.Z. J. Sci. Tech.*, B34: 291-316.
- MANTON, Irene and SLEDGE, W. A., 1954. Observations on the cytology and taxonomy of the pteridophyte flora of Ceylon. *Phil. T. R. Soc. Lond.*, 238: 127-185.
- OLIVER, W. R. B., 1935. The genus *Coprosma*. *Bishop Mus. Bull.* 132.
- , 1948. The flora of the Three Kings Islands. *Rec. Auck. Inst. Mus.*, 3: 211-238.
- , 1951. The flora of the Three Kings Islands: Additional notes: with note on *Suttonia*. *Rec. Auck. Inst. Mus.*, 4: 111-112.
- , 1956. The Three Kings Cabbage Tree. *Rec. Auck. Inst. Mus.*, 4: 381.
- PANTIN, H. M., 1959. The sea floor around New Zealand, in *Descriptive Atlas of New Zealand* (A. H. McIntock, Ed.). Govt. Printer, Wellington.
- POWELL, A. W. B., 1955. Mollusca of the Southern Islands of New Zealand. *CAPE Exped. Ser.*, Bull. 15, D.S.I.R., Wellington.
- , 1960. Antarctic and Subantarctic Mollusca. *Rec. Auck. Inst. Mus.*, 5: 117-214.
- RIDLEY, H. N., 1930. The dispersal of plants throughout the world. London.
- SALMON, J. T., 1948. Collembola from the Three Kings Islands with a description of *Proisotomina*, New Genus. *Rec. Auck. Inst. Mus.*, 3: 291-300.
- SELLING, O., 1947. Studies in Hawaiian pollen statistics. Part II. The pollens of the Hawaiian Phanerogams. *Bishop Mus. Spec. Pub.* 38.
- SKOTTSBERG, C., 1956. Derivation of the flora and fauna of Juan Fernandez and Easter Island. In *The Natural History of Juan Fernandez and Easter Island*, 1: 193-438.
- STANLEY, E. A. and KREMP, G. O. W., 1959. Some observations on the geniculus in the pollen of *Quercus prinoides*. *Micropal.*, 5: 351-354.
- van STEENIS, C. G. G. J., 1928. The Bignoniaceae of the Netherlands Indies. *Bull. Jard. Bot. de Buitenzorg*, Ser. 3, 10: 1-2.
- WILLIS, J. C., 1949. The birth and spread of plants. *Boissiera*, Vol. 8 (reprinted by The Chronica Botanica Co., Waltham, Mass., U.S.A.).

## ILLUSTRATIONS

- 1: *Photomicrographs*: All were taken by the author, mainly with the use of a Wild M20 microscope and its 50X and 100X Fluorite objectives. Magnifications have been varied to suit the material: better general impressions of microspores can often be obtained at lower magnifications without the use of oil immersion as for the objectives mentioned. Unless otherwise stated the spores and pollen grains are shown at 1000 diameters, for ease in comparative measurement.
- 2: Flowering *Tecomanthe speciosa* (Pl. 49, Fig. 27). This study of a young cultivated plant was made by Mr. Harley Powell while photographer with the Plant Diseases Division, Mount Albert.



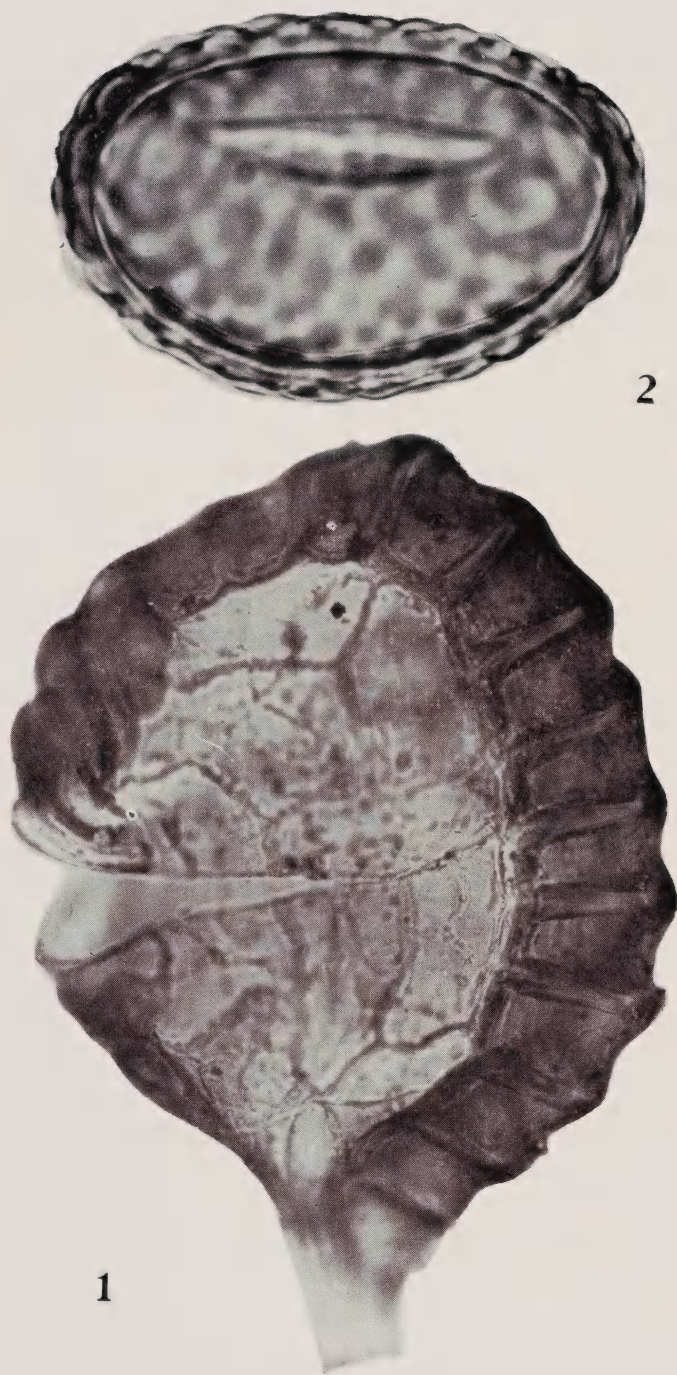
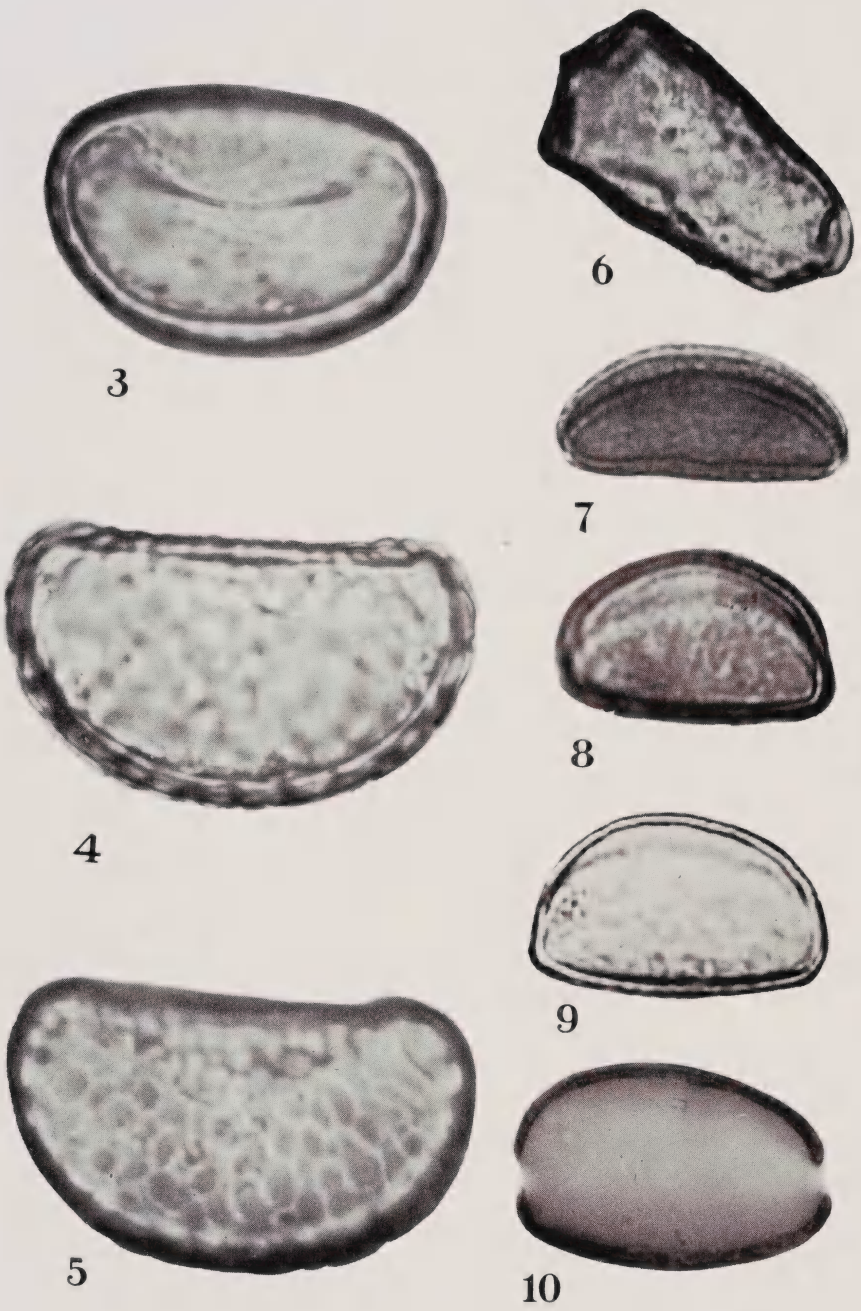


Fig. 1. Ruptured sporangium of *Davallia tasmanii*.

Fig. 2. Spore, in slightly oblique view, showing gapping scar (laesura). Lactophenol preparation.

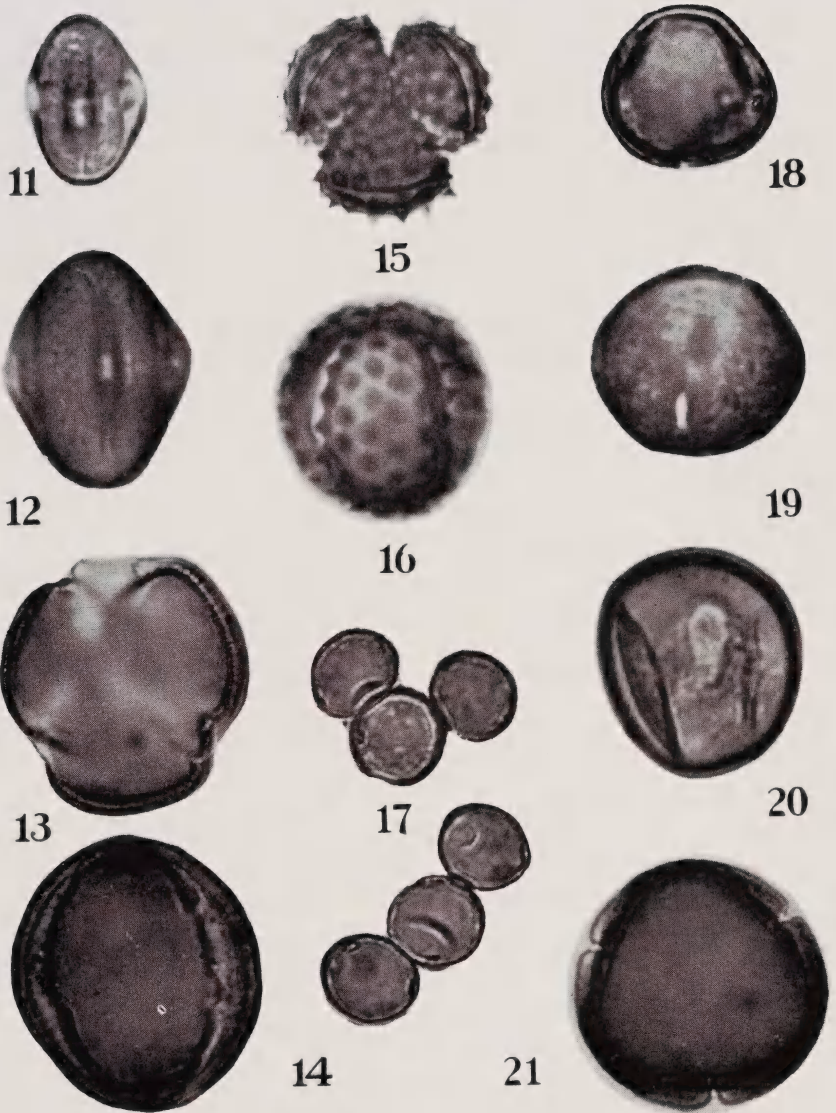




Figs. 3-5. *Davallia tasmanii*: side view of spores at varying focus; (3) unexpanded spore with depressed scar area, (4, 5) spore seen at lower levels than in Fig. 2.

Fig. 6. *Carex clingamita*: elongate grain.

Figs. 7-10. *Cordyline kaspar*: (7-9) side views, furrow at top, (10) ruptured grain in optical section: (7) shows immature grain separated from its tetrad.



Figs. 11, 12. *Elingamita johnsoni*: side (equatorial) views.

Figs. 13, 14. *Hebe insularis*: (13) slightly oblique polar view; (14) side view.

Figs. 15, 16. *Brachyglottis repanda* var. *arborescens*: (15) polar view, (16) side view.

Fig. 17. *Paratrophis smithii*: six clustered grains.

Figs. 18, 19. *Plectomirtha baylisiana*: (18) polar view, optical section; (19) side view showing poroid aperture.

Fig. 20. *Myrsine oliveri*: side view, showing a gaping aperture.

Fig. 21. *Coprosma macrocarpa*: polar view, optical section (see also Fig. 26).



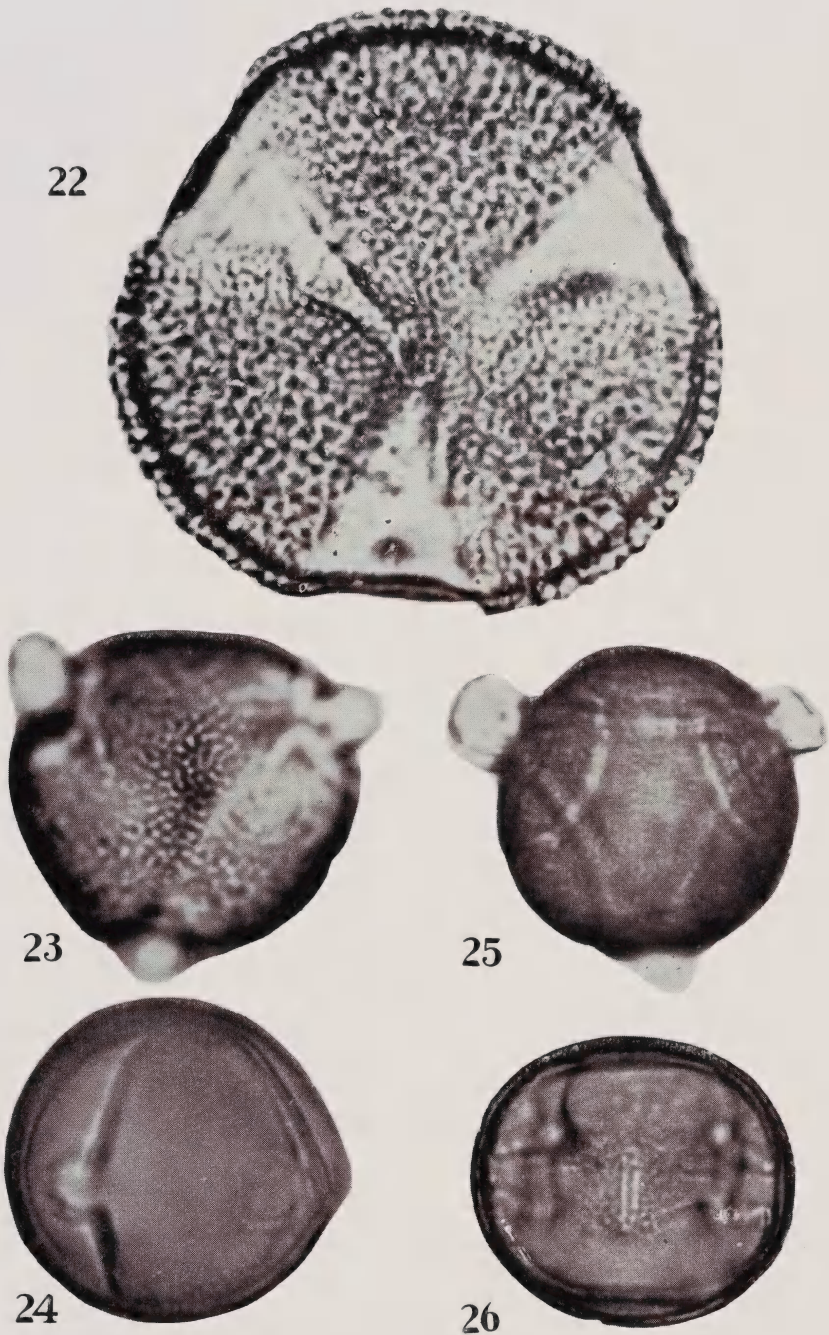


Fig. 22. *Tecomanthe speciosa*: polar view showing large furrows with their heavy exine and jumbled reticulum as seen below the surface.

Figs. 23, 24. *Pittosporum fairchildii*: (23) polar view of grain with distended pore membranes and coarse exine pattern; (24) side view showing one pore clearly; reticulum finer.

Figs. 25, 26. *Coprosma macrocarpa* (see also Fig. 21): cell contents pushing out from wide vestibules, polar view; (26) side view showing flattened poles, coarser pattern around the aperture in focus. Vestibules collapsed after loss of cell contents.



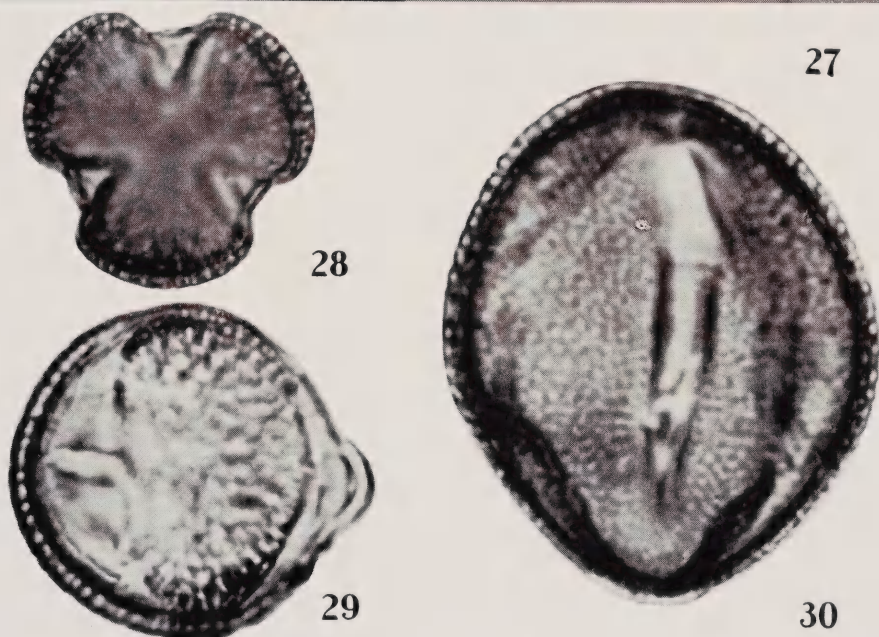


Fig. 27. *Tecomanthe speciosa*. Flower clusters emerging from woody stem of a young plant. Note inversion of corolla. Harley Powell photograph.

Figs. 28-30. Polar view (28) showing reticulum in section; (29) tilted side view showing rifts in one furrow and bulging segment in another; (30) side view of grain with finer pattern and one furrow torn in two areas, 2000X.